

**DEPARTMENT OF THE ARMY**

**COMPLETE STATEMENT**

**OF**

**THE HONORABLE JOHN PAUL WOODLEY, JR.  
ASSISTANT SECRETARY OF THE ARMY (CIVIL WORKS)**

**BEFORE THE**

**COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE  
UNITED STATES HOUSE OF REPRESENTATIVES**

**ON**

**THE ARMY CIVIL WORKS PROGRAM'S RESPONSE TO CLIMATE  
CHANGE AND ENERGY INDEPENDENCE**

**MAY 11, 2007**

Mr. Chairman, and distinguished members of the Committee:

Thank you for the opportunity to testify before the Committee and to present my views on the U.S Army Civil Works Program's response to global warming and energy independence.

## OVERVIEW

For thousands of years human civilizations have risen, prospered, and declined depending on their ability to adapt to changes in weather patterns especially floods and droughts. Over the last century, the U.S. Army Corps of Engineers (USACE), the Bureau of Reclamation, and other Federal agencies have helped develop this Nation's water resources. We are taking steps to improve our ability to manage those resources and are now addressing the water-related issues that might arise in the next few decades from changing weather patterns.

USACE plans, constructs, and operates many projects that could be affected by climate change and conducts related studies. Some examples of our responsibilities include:

- Coping with droughts and floods due to changing precipitation patterns;
- Evaluating the implications of changes in hurricane frequency or intensity along our coasts;
- Addressing changing needs and values by balancing water allocation among competing users;
- Designing and managing USACE projects in ways that anticipate and can adapt to changing conditions.

USACE is working with other Federal agencies – the National Oceanic and Atmospheric Administration (NOAA), the U.S Environmental Protection Agency (USEPA), the U.S Geological Survey (USGS), the Natural Resources Conservation Service (NRCS) and Bureau of Reclamation – to share information on the complex and technically difficult aspects of our respective responses to climate change in the many areas where our programs overlap.

USACE's flood and storm damage reduction mission directly involves understanding and responding to the extremes of climate variability. A significant change in climate could also affect our ability to supply water from our multipurpose reservoirs to 55 million municipal and industrial consumers; facilitate safe and secure waterborne transport on some inland waterways and produce nearly 25% of the nation's hydroelectric power. It could also affect our

ability to restore and sustain aquatic ecosystems and endangered and threatened species.

The USACE has the capacity and necessary authorities to comprehensively examine the uncertainties, threats and vulnerabilities on water infrastructure and to implement the necessary adjustments as part of a proactive adaptive management program. For example, in PL 99-662 (WRDA '86), the Congress authorized a study of the impacts of a possible rise in ocean levels (Section 731); a study on national capital investment needs for water resources infrastructure (Section 707); and a comprehensive assessment of water resources needs of river basins and regions (Section 729). We are also assessing the vulnerabilities of existing Corps water infrastructure and providing recommended courses of action for Federal, state and local partners on a variety of matters, as I will lay out in the remainder of my testimony.

## **CONTEXT OF THE USACE RESPONSE TO CLIMATE CHANGE**

The Civil Works program is working to deal with the practical ramifications of changing weather patterns, and to develop sensible strategies in our areas of responsibility that anticipate various scenarios where these trends may intensify.

Generally, it is the large uncertainties that create substantial challenges for planning new public works, and even more so in operating our existing water resources systems. There are difficult decisions surrounding basic questions whose complexity would be compounded by climate change. At any given location, for example, we may need to determine:

- What is the appropriate level of flood and storm damage reduction, and what is the residual risk to those living and working once we build a levee, floodwall, dam, or other structure or implement a non-structural solution;
- How to characterize and identify a 100-year floodplain in coordination with FEMA's specifications;
- How to adaptively manage a reservoir to accommodate an increasingly uncertain spring runoff;
- How should reservoir storage be allocated among the competing needs, now and in the future;
- What criteria should be used to "recertify" flood mitigation structures where the flow frequencies have changed or are in the process of changing; and,
- How should our contemporary ideas on life-cycle infrastructure management and performance accommodate our evolving scientific understanding of climate change?

The uncertainties associated with climate change are additional factors that will compound the complexity of these issues. The USACE is addressing these issues, with no easy answers or solutions. However, we are committed to

devising a sensible way forward, in cooperation with the many others, including Federal and state agencies and private interests, who also deal with these matters.

### **LIFE-CYCLE MANAGEMENT OF AN AGING WATER RESOURCES INFRASTRUCTURE**

The Civil Works program has oversight, regulatory or inspection responsibilities for a portfolio of 1600 water resources projects, programs and systems. We view our responsibilities from a life-cycle standpoint, which starts with our planning processes and engineering and ecosystem management designs, and continues with the development and implementation of project and system operating plans that will enable us to better adapt to any changing conditions.

The USACE does not collect or interpret most of the basic scientific and physical information related to climatology – precipitation, evaporation, snow pack, wind speed, soil moisture or sea level rise, etc. – that explain climate change trends. This is accomplished primarily through others, including NOAA, USGS and the National Aeronautics and Space Administration (NASA) and publicly funded research efforts.

### **PROACTIVE ADAPTIVE MANAGEMENT**

In many respects, “adaptive management” represents a prudent component of a sensible approach to infrastructure life-cycle management. For the next decade or so, the nation’s existing water resources infrastructure can, in most cases, be adapted to address subtle changes and trends in the hydrology and climatology with a proactive use of existing policies, programs and water management practices.

An integrated approach to evaluation of the impacts and response to Hurricanes Katrina and Rita exposed and highlighted the monumental challenge in responding to large-scale disasters, and has motivated the USACE to take serious stock of its planning and engineering methods and standards for evaluating, managing and responding to extreme events, and how they might be dealt with as part of climate scenarios that reflect different degrees of change from our historical expectations.

In many cases the climate changes we are experiencing are still within the “norms” of weather and climate variability, which our existing water resources infrastructure was designed to accommodate. Nevertheless, the USACE has engaged its researchers, planners and reservoir operators, as have other Federal agencies, to try to better understand the nature of these changes and to begin to develop methods that could help our planners and operators begin to deal with shifting trends.

The USACE is exploring ways to improve how to plan water resources public works, so that they are robust and resilient enough for an extreme storm event where justified, with due consideration for the uncertainty in the frequency and magnitude of such storms. USACE is working on ways to design projects with allowances for performance monitoring, adaptation and life-cycle management. The Administration has requested more funding for operation and maintenance and has proposed to transfer the funding and responsibility for rehabilitations to the operation and maintenance program. This will help ensure that the key components of the existing USACE inventory are properly maintained and provide the necessary safety, resiliency and reliability.

As part of our past project design, we've known that hurricanes of the magnitude of Katrina (and greater) were possible, even within what we consider "normal" climate variability, but it is difficult to predict the frequency of such events and we are still developing our understanding of how the intensity and frequency of such storms would alter under different climate change scenarios. Generally, however, we have formulated our projects to address storms that are more likely to occur. Similarly, our cities typically design their urban drainage systems for smaller but more frequent events. On the other hand, in cases of dam safety, we design spillways for very infrequent floods, roughly of a 10,000 year return period.

## **RISK-BASED PLANNING**

The USACE is pursuing the expanded use of risk-based planning. The risk-based planning process considers uncertainties such as the effects of climate change, evaluated through multiple possible scenarios of the future. The ongoing work on the Louisiana Coastal Protection and Restoration study is an example of the application of this process.

The recently completed comprehensive International Joint Commission (IJC) study of the Lake Ontario-St. Lawrence River operating rules, relied explicitly on the ability of alternative regulation plans to function under four different climate scenarios. A similar study just initiated of the International Upper Great Lakes will also consider conditions resulting from climate change.

There are numerous other venues and opportunities for the USACE to promote these types of analyses and discuss a broader view on climate variability. For example, the USACE serves as principal advisor on numerous interagency Water Control (regulation) Boards, such as those for the International Joint Commission. There are twelve Boards for the watersheds and river basins that straddle the U.S.-Canadian border, and most are now beginning to consider climate change in their operations.

The USACE has been very active in supporting many of the U.S. Government's initiatives in working with a broad array of United Nations institutions to

implement the "Millennium Development Goals" (MDG), focusing on those that address water resources management and providing drinking water and food security to developing nations. As part of this effort, the USACE has aligned itself with a number of global water partnerships, such as the World Water Council and the Global Water Partnership, whose focus is on developing policies and mechanisms for implementing the MDGs.

The USACE was also instrumental in revitalizing the new U.S. National Committee for contributing to UNESCO's International Hydrologic Program (IHP). The IHP program is geared towards developing new approaches to integrated water resources management, with an emphasis on how climate change may be factored into the analysis and design of water management projects. Associated with the U.S. National IHP efforts, in which the USACE is partnering with many Federal agencies, universities and Non Governmental Organizations (NGOs), the USACE has entered into a series of Memoranda of Understanding with international centers of expertise that are part of the UNESCO devoted to water issues, including climate change. One of the key programs in which the USACE will be centrally involved is the International Flood Initiative (IFI), working with Japan's International Center for Water Hazards Flood Risk and Risk Hazard Management (ICHAARM).

### **THE USACE ENVIRONMENTAL OPERATING PRINCIPLES**

The USACE has reaffirmed its commitment to the environment by formalizing a set of "Environmental Operating Principles" applicable to all its decision-making and programs. These principles foster unity of purpose on environmental issues, reflect a new tone and direction for dialogue on environmental matters, including climate change, and ensure that USACE considers environmental issues in all USACE activities. The Administration's wetlands goal, proposed in 2004, is designed to not only limit wetland losses, but to expand the quality and acreage of wetlands across the nation. By reducing hydrologic variability in river systems (i.e., serving as storage for water) and providing a buffer to coastal storm surges, wetlands perform an important function that would become more valuable under a changing climate scenario.

### **HIGHLIGHTS OF CIVIL WORKS ACITIVITIES RELATED TO CLIMATE CHANGE AND VARIABILITY**

Soon after Hurricane Katrina, the USACE initiated a series of actions that built on its previous work in risk analysis, and incorporated contemporary life-cycle infrastructure management principles, which include dealing with uncertainties through a "proactive adaptive management" approach. Similar risks and uncertainties would come into play under climate change. The planning and analytical evaluation processes of the USACE have been updated and upgraded

to explicitly encompass the risk and uncertainty components of the decision-making processes. The USACE has developed a 'scenario-based' planning and evaluation framework that is coupled with a better system for conveying risk and uncertainty information in a participatory public information framework.

## **NATIONAL FLOOD RISK MANAGEMENT PROGRAM**

The reliability of the nation's aging flood and storm damage reduction infrastructure is affected by a number of factors. A changing climate could lead the nation to rethink how flood risk is assessed, communicated, managed and mitigated, and affect how and where we develop our communities in the future. Under the USACE's National Flood Risk Management Program, we are conducting an inventory of the nation's levees and will then assess their condition to determine if they will function at their design level. This effort is being coordinated with the Federal Emergency Management Agency (FEMA). FEMA has embarked on a billion dollar, 5-year program to update the nation's flood maps, known as the Map Modernization (MapMod) Program. The USACE has been actively supporting FEMA with reimbursable work on MapMod products, development of technical and funding guidance for levee certification, and the establishment of the Interagency Flood Risk Management Committee to allow senior executives to meet on a regular basis. The USACE and FEMA have also started the "Silver Jackets" collaborative planning program to better coordinate the Federal and state programs that can address a community's flooding problems. Collectively, these efforts are aimed at improving the nation's resiliency to the impacts of floods and storms both under present conditions and future climate scenarios.

## **12 ACTIONS FOR CHANGE**

The principal "centerpiece" for the USACE's approach resides in what the Chief of Engineers introduced, as the "12 Actions for Change." The 12 Actions for Change were developed in response to the aftermath of Hurricane Katrina, and are focused on a systematic approach to better quantifying and communicating risk, uncertainty and safety considerations in our various endeavors; engaging the public; investing in research; and continuously reassessing and updating the Civil Works policies, planning guidance and design standards as part of an overall 'proactive adaptive management' approach.

## **USACE'S CLIMATE CHANGE WORKING GROUP**

Under the direction of the Headquarters Directorate of Civil Works, the USACE is launching an effort to assess and develop a proposed comprehensive strategy for responding to the effects of climate change across the full range of its water

resources missions. This effort will aim to develop strategic policy and programmatic guidance for activities over the next decade including ongoing studies, as well as reviewing and upgrading existing programs and guidelines to increase planning and operational flexibility as part of a proactive adaptive management strategy.

## **WATERSHED STUDIES AND INTERAGENCY COLLABORATION**

At the field and interagency levels, the USACE has been developing and advocating new approaches related to adapting to uncertainties such as those presented by climate change. In some cases, alternative solutions developed by the USACE have explicitly considered climate change as a potential risk factor. For example, communities along the Upper Mississippi River questioned whether their flood risk changed following the 1993 flood. In addressing this concern, the USACE conducted the Upper Mississippi River Basin Flow Frequency Study to update flood profiles for the Mississippi River from St. Paul, MN to the confluence with the Ohio River, the Missouri River from Gavins Point to the mouth, and the Illinois River. In addition to traditional flood frequency analysis, the analysis examined long-term climate trends and the potential uncertainty due to climate change.

The USACE is participating in the National Shoreline Management Study, an interagency effort to examine the status of the nation's shorelines and coordinate the various Federal, state and local perspectives on many issues, including the possible effects of climate change.

In addition, the USACE has initiated or participated in a number of workshops with its Federal and state agency partners that are designed to evaluate the development of technical and scientific methods for incorporating climate change information into forecasts, flood and drought frequency analysis and planning evaluation approaches for new projects, as well as for existing ones.

One such national effort is the upcoming USGS/NOAA/USACE/Bureau of Reclamation Headquarters Climate Roundtable. This effort, which is complemented by regional partnerships, such as an ongoing series of technical Interagency Climate Workshops, collaboration among the Bureau of Reclamation, California and the USACE, was initiated to develop more dynamic adaptive management strategies for California's reservoirs and flood protection systems, as well as its water supply and irrigation needs.

## **OPERATION AND MAINTENANCE**

USACE can also address climate change as part of its effort to increase the resiliency and reliability of key existing infrastructure by instituting monitoring



programs and updating the hydrologic data base and the operating rules and criteria that are used to operate reservoirs, along with flood and drought management contingency plans, and Section 216 studies and associated efforts under P.L. 85-500 for the reallocation of reservoir storage.

USACE reservoirs can provide a buffering capacity for coping with the vagaries of climate variability and change. With the exception of a few large systems, most reservoirs have not had their operating plans updated for decades. This systematic updating could include new flood and drought frequency information, along with testing the resiliency and robustness of the systems under different climate change scenarios.

### **EMERGENCY PREPAREDNESS**

The USACE is familiar with the hazards that natural disasters, such as tsunamis, extreme hurricanes, tornados, landslides, earthquakes or prolonged droughts can pose, as occurred in Hurricane Katrina and the Loma Prieta earthquake. Scientists are still in the early stages of being able to understand the connections between ocean temperature increases (El Niño) and mechanisms of weather patterns that lead to hurricanes and droughts. For example, the year 2006 was projected to be an active one for Atlantic hurricanes – yet none made a U.S. landfall. The USACE's "Advanced Measures Initiative" program allows it to determine areas where there is an imminent threat to public safety, for example from rapid snowmelt and flooding, or increased erosion and flood damage during high lake levels in the Great Lakes, and undertake preventive measures to reduce the risk to populations. Waterways transport is an important part of the nation's transportation system. It can be affected by hurricanes or floods, and by droughts like those of the 1930's and more recently in the late 1980's. Similarly, hydropower production is important, particularly in the Northwestern States, and its curtailment during droughts would add to the cost of power in those regions.

### **REGULATORY PROGRAM**

Concerns about climate change are also affecting the USACE Regulatory Program. Under the Rivers and Harbors and Clean Water Acts, the USACE evaluates Federal, non-Federal government, and private proposals for actions affecting waters of the United States, including wetlands and the territorial seas.

When the Regulatory Program reviews a permit application for an action that would have significant environmental impacts (including but not limited to the impacts on waters of the United States), it generally considers the full environmental impacts of the action. Corps regulators have been asked to take positions on, or make judgments regarding, climate change for proposed actions subject to our jurisdiction in several States where we have joint permitting

procedures, regional general permits, and State Programmatic General Permits, or in States that have passed legislation with specific regulatory requirements pertaining to potential changes in climate. For example, in some cases, regulators in the District offices are already being asked to consider the impact that the added emissions resulting from a proposed action could have on future climatic patterns.

In general, climate change concerns tend to arise for larger, more complex projects, particularly those with long use lives such as energy and transportation projects. Hence, together with other regulatory agencies, we have begun to discuss how, or if, climate change should be addressed in the regulatory process. We may need to develop science-based evaluation tools to aid decision making. Also, while climate change concerns generally are not raised for smaller projects such as those authorized under general permits, private dock owners in some cases have asked the Corps to authorize a larger project – possibly with greater adverse environmental effects on waters of the United States, before mitigation – as a cushion or protection against the risk that floods, coastal storms floods, or a sea level rise may become more common in the future.

## **RESEARCH & DEVELOPMENT**

The USACE has been involved in climate change impact studies since 1979, and has also sponsored, organized, and conducted numerous interagency conferences and technical workshops related to global warming. Past research investigated the potential impact of climate change on eight water resources systems that varied in size from a municipal water supply to the Missouri River Basin. Current research efforts are examining how changes in snow pack and the timing of snowmelt can be incorporated into modifications of reservoir operating rules for USACE projects in the Western United States.

The USACE Cold Regions Research and Engineering Laboratory (CRREL) research on ice cores from glaciers and polar ice sheets, cores from tree rings, and ocean-floor sediments provides a timeline of changes from the Ice Ages to the present day. These and other efforts by scientists to understand and predict the impact of potential climate change will help the USACE to develop a long-term strategic planning perspective and adapt its environmental stewardship, mitigation, and aquatic ecosystem restoration efforts to climate change.

The USACE's Research and Development Program may also be able to help bridge the gap between the scientific products flowing from basic climate change research performed by others across multiple U.S. and international agencies and institutions, and the need for applied research to develop methods, models and systems that will support a more dynamic and adaptive approach to reduce the risk from floods and storms.

The USACE will be able to include new information into its water management and control operations, because it has already implemented a nationally consistent, integrated system to operate all of its lakes and reservoirs across the U.S. This system, known as the Corps Water Management System (CWMS), has integrated a suite of software models of rainfall-runoff, snowmelt, and reservoir operation processes directly into operational decision making, allowing the adoption of new operation strategies quickly and efficiently. CWMS allows water control operators in USACE district offices to predict the consequences of operations under revised rules before the gates on the dams are moved.

A comprehensive systems type analysis would be required to apply the new analytic tools to evaluate and address the impacts of global climate change in any specific location. The USACE's Hydrologic Engineering Center (HEC) has been developing such an interface called the Watershed Analysis Tool (HEC-WAT or the WAT). The primary purpose of the WAT is to streamline and integrate a water resources study such as a reservoir re-operation study using software commonly applied by multi-disciplinary teams. The WAT is the planning version of the CWMS software. The WAT will include the ability to perform risk analysis through the traditional approaches and will also facilitate the use of scenario-based analysis.

### **USACE ADVISORY BOARDS**

Any significant sea level rise would have an impact on coastal flooding and erosion. The USACE developed technical guidance in 1987 on factoring in sea level rise scenarios as part of project planning and design. The Coastal Engineering Research Board (CERB) provides advice to the Chief of Engineers on research priorities and new initiatives, as does the Environmental Advisory Board (EAB). Both have suggested ways in which the USACE can deal with climate change and variability.

### **CIVIL WORKS ACTIVITIES CONTRIBUTING TO ENERGY INDEPENDENCE**

The USACE is the single largest producer of hydroelectric power and energy in the United States. The USACE operates and maintains 75 multiple purpose hydropower projects with a total hydroelectric power capacity of nearly 21 thousand megawatts (MW) generating about 78 billion kilowatt-hours (kWh) of electricity per year. The USACE accounts for about 24% of hydroelectric power capacity and about 3% of total electric power capacity in the United States. This output makes the USACE the fourth largest electric utility in the United States behind the Tennessee Valley Authority, Commonwealth Edison and Georgia Power.

The Administration continues to invest in improving the efficiency and reliability of the inland navigation system. Over a comparable distance, barge traffic is more energy efficient than rail or truck for equivalent cargo volume. For example, according to data compiled by the U.S. Department of Transportation Maritime Administration, when comparing the relative energy efficiencies of different modes of transportation, for one gallon of fuel, trucks can carry one ton of cargo 59 miles, rail can carry one ton of cargo 202 miles and an inland barge can carry one ton of cargo 514 miles.

## **CONCLUSIONS**

There are many avenues through which the U.S. Army Corps of Engineers Civil Works program can help address the difficult scientific, technical and operational issues raised by the uncertainty associated with climate change and its potential impacts on water resources management. The USACE has the necessary authorities to conduct a broad program of necessary first steps that are part of a longer-term proactive adaptive management strategy. The USACE is a leader in innovative, yet practical, cost-effective approaches, and is working to incorporate potential climate change impacts in the planning and management of our key water-based infrastructure. We are well positioned to respond to the nation's needs now and in the future.